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ABSTRACT

At the present time, state mandated testing is solely in mathematics and reading, so it behooves schools to provide the best mathematics curriculum. Adults who are deficient in numeracy face difficulties in the societal arena. Objectives in mathematics need to be carefully selected by the teacher. Three categories of objectives should be stressed: knowledge, skills, and attitudes. This paper discusses the following four sources of objectives for student achievement: those in the manual section of a carefully chosen basal textbook; those which a state mandates for learner achievement; those cited by the National Council of Teachers of Mathematics (NCTM, 1989); and those defined by the learners themselves. The paper suggests various ways to involve students in determining the mathematics curriculum. It discusses key ideas which students need to achieve in a developmental mathematics curriculum, as well as key ideas for teachers to use in teaching. The paper also suggests the use of teaching aids, which have been made by teachers for their use. It lists five ways for teachers to assess student progress in mathematics. (NKA)

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Reading, Mathematics, and the Pupil.

by Marlow Ediger

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READING, MATHEMATICS, AND THE PUPIL

Mathematics and numeracy are high on the list in importance in the curriculum. It has always been considered a basic and one of the long standing 3r's. With state mandated testing in mathematics and reading solely, at the present time, it behooves the school to provide the best mathematics curriculum than ever before. Then too, mathematics learnings need to be applicable in society. Those adults who are deficient in numeracy do face difficulties in the societal arena. An adult who cannot function well in the world of mathematics is certainly handicapped. Everyday transactions in buying goods and services make it imperative to become proficient in the use of number and numerical symbols.

Objectives for Pupil Achievement

Objectives need to be selected carefully in mathematics. Teachers need to be highly knowledgeable about subject matter in mathematics. The facts, concepts, and generalizations to teach must be useful presently as well as in the future. Thus, school and society should not be separated from each other in the mathematics curriculum.

Three categories of objectives should be stressed. These include knowledge, skills, and attitudes. Knowledge acquired must be applied (skills), and a by product of learning for pupils should be good attitudes toward mathematics.

One source for mathematics objectives is the manual section of a carefully selected basal textbook. These objectives have been chosen by writers who are specialists in the field of mathematics. The teacher needs to appraise the worth of each end. The following questions need to be answered when choosing objectives:

1. Are they clearly stated to provide direction in teaching?
2. Are they worthwhile to achieve presently as well as for utilitarian use in the societal arena?
3. Is there a rational balance among knowledge, skills, and attitudinal ends?
4. Do they adequately stress logic, critical and creative thinking, as well as problem solving?
5. Will the chosen learning opportunities for pupils assist in achieving the desired ends?
6. Are the objectives developmentally appropriate for pupils? (Ediger and Rao, 2000, Chapter One).

A second source of objectives are those which a state mandates for learner achievement. These ends are chosen on the state level under the supervision of the department of education. These are generally given in grades three through eight. The attempt by the state is to determine if a pupil has achieved what is deemed important in mathematics. A printout of pupil results, after having taken the test, may provide information on what the pupil is lacking in mathematics achievement. The test results may also indicate if a pupil is to pass on to the next higher grade level. The later, called high stakes testing, means that pupils and the teacher need to put forth serious effort in learner mathematics achievement. The state mandated test is to be aligned with the objectives, available to teachers as benchmarks for teaching. There is also room for teacher selection of objectives within the framework of state mandated ends.

A third source of objectives may well come from the National Council Teachers of Mathematics (NCTM, 1989). These objectives are a valuable source for teachers to voluntarily choose from for pupil attainment. The NCTM standards, for example, provide the following listing for pupils in grades 5 - 8 pertaining to Communications, Reasoning, and Connections:

* model situations using oral, written, concrete, pictorial, graphical, and algebraic methods;
* reflect on and clarify their thinking about mathematical ideas and situations;
* develop common understandings of mathematical ideas, including the role of definitions;
* use the skills of reading, listening, and viewing to interpret mathematical ideas;
* discuss mathematical ideas and make conjectures and convincing arguments;
* appreciate the role of mathematical notation and its role in developing mathematical ideas.

In objective number one above, for example, a pupil may indicate what has been learned through discussions (oral); written (such as daily work shown from working problems using the basal text); concrete (objects and items), pictorial (to show quantities and the basic four operations); graphical (line and bar graphs); algebraic (solving for the unknown can be begun on the first grade level and earlier, if readiness is there).

The NCTM objectives may well be added to the previous two sources such as teacher determined and state mandated ends. They have been developed by a national group, specializing in

the teaching of mathematics. Teachers need to become highly familiar with NCTM objectives in developing a quality mathematics instruction.

Learning Opportunities

A fourth source of objectives for the mathematics curriculum might well be learners themselves. These objectives also involve learning opportunities for pupils to achieve objectives. The following are ways to involve pupils in determining the mathematics curriculum:

1. pay careful attention to and answer pupil questions in ongoing discussions when a new process has been introduced.
2. have pupils work in small groups to do and complete assignments. Leadership skills might well be developed here.
3. ask pupils for every day problems met up with in the use of number.
4. engage pupils in selecting materials to use and problems to solve at a learning center for learners to work at, during spare time, as enrichment experiences.
5. develop a mathematics laboratory, with learner input, whereby pupils may measure length, find areas and volume, of geometric figures and containers. The data obtained may be recorded and compared among learners.
6. make a bulletin board display involving pupils on the importance of mathematics. The display should be changed periodically to reflect new math ideas.
7. encourage pupil achievement and pride in being good mathematicians. Have pupils develop a chart on famous mathematicians with both men and women pictured.
8. establish a math club with pupils serving in different offices such as president, vice- president, and secretary. The president guides, with teacher assistance, in determining topics to discuss. Fascinating topics, among many others may include Pythagorus in ancient Greece and his beliefs that everything in the world consisting of numbers. Another ancient Athenian, Plato, believed that the highest category of citizens (rulers of his ideal Republic) should know mathematics in their entirety. Euclid developed Euclidian geometry, still studied and taught presently. These are three great mathematics thinkers in the ancient world.
9. make math models for teaching and learning as well as to show to other classrooms as an exhibit. These models might also be placed in a display case in the hallway. Two dimensional squares, rectangles, triangles, trapezoids,circles, among others) and three dimensional models (cubes, rectangular solids,

spheres, triangular solids, cones, pyramids, among others) may be made and shown.

10. mathematics library books should be neatly displayed for pupil reading. Each pupil should be able to check out a book readily to read and share its contents with others in a small group. A library book may also be read by the teacher to pupils during story time (Ediger, 1998, Chapter Five).

A mathematics textbook, single or multiple series, along with other activities, can provide valuable subject matter for pupils in mathematics. Pupils may need assistance in the reading of contents from the basal. The teacher or peers may provide this assistance. The author, as an elementary school teacher, noticed that word problems were difficult for many due to pupil difficulties in reading. The following procedures may be used to assist pupils in reading mathematics content:

1. The teacher read aloud selected word problems as pupils follow along in their textbooks.

2. The teacher use a Big Book methodology whereby a book with large print for all to see clearly is available. Here, learners are seated in a semi-circle in front of the book with large script. The teacher is able to monitor attention better with a single script for all to follow as compared to pupils' following the read aloud from their own texts, mentioned in number one above. After the read aloud by the teacher as he/she points to words being read, pupils together with the teacher read orally the mathematics word problems. Rereading might be done as often as necessary. Pupils should then be ready to go to their desks to work the word problems from their own textbooks.

3. The teacher writes new words from the lesson text on the overhead and introduces them orally, together with their individual meanings, to pupils before learners are to work the story problems. Learners then should apply these readiness factors in doing the word problems.

4. Pupils scan the word problems prior to their actual reading. They identify words which might cause difficulties in identification. These are printed neatly by the teacher on the overhead, pronounced, and meaning attached to each word.

5. A committee of pupils identifying possible unknown words to be identified and they are given to the teacher. The teacher then pronounces each word carefully from the overhead and provides a contextual meaning. Pupils may also be asked to identify each word and its related contextual meaning. Pupils are then more actively involved in the mathematics lesson.

In the oral introduction of new words, the teacher may feel that word recognition techniques should be taught at this point and time. These learnings should not distract from the teaching of mathematics, but rather assist pupils to do better in this academic arena. There might be selected phonics procedures which may benefit pupils. Thus, important grapheme/phonemes should be chosen and taught, only, which relate directly to the word problems to be encountered.

Second, needed in text syllabication skills might also be taught. There are very common syllables, such as "un" which might be taught.

Third, structural analysis skills might well help pupils to identify words quickly in mathematics. Words have structure such as those with "s" or "es" endings indicating a plural form of the word.

Fourth, pupils might notice that some words are longer or have taller letters than others. This assists pupils to identify words through configuration clues. It might well be helpful to have pupils make discoveries on the shape or form of an unknown word.

Fifth, context clues, perhaps, are the most important for pupils to use when attempting to identify unknown words. A word must make sense when put into the place of an unknown word. The teacher needs to guide pupils to use words making sense in place of the unknown. Context clues and the initial consonant sound of an unknown word helps the pupil to identify the correct word in context (See Harris and Sipay, 1985).

In addition to word recognition skills, pupils need to comprehend what is read in mathematics. Critical and creative thinking as well as problem solving then must be stressed in each lesson in mathematics.

Key Ideas in Mathematics

There are key ideas which pupils need to achieve in a developmental mathematics curriculum. Pupils need guidance to notice patterns in mathematics. Achieving understandings of important patterns assists the learner to use this information in future lessons in mathematics. Thus meaningful operations on number; being able to comprehend counting by twos, fives, tens; using base ten place value; among others, makes mathematics orderly and understandable. The great philosopher Descartes (1596- 1650) used mathematics due to its precision and consistency as the basis for seeking Truth. He wanted to know exact knowledge, in ultimate reality, and believed that

mathematics emphasized certainty. Descartes used principles of mathematics in attempting to find certainty in beliefs by advocating an individual begin with a statement of definite certainty and then write additional ideas deductively of which certainty still exists. This process of deductive thinking is stressed until surety is no longer possible. John Dewey (1859-1952) believed that certainty cannot be found. His philosophy of problem solving was called experimentalism. John Dewey then emphasized that certainty does not exist, but one experiences the natural and social environment. With experiences, an exact replica is then not provided of preciseness. However, perceived problems are identified, hypotheses developed, and solutions sought. New problems might well arise as a problem is being solved. Solutions are tentative only and always subject to revision. In mathematics, there is preciseness such as in basic addition, subtraction, multiplication, and division facts. There is also tentativeness such as in estimations made. However, mathematics, perhaps, is as objective a body of knowledge as compared to any academic discipline (See Strumpf, 1971).

Second, mathematics contains structural ideas which always hold true such as the commutative, associative, and distributive properties of addition and multiplication. The additive and multiplication identity also hold true in consistency as does subtraction being the inverse operation of addition and division the inverse operation of multiplication.

There are also key ideas for teachers to use in teaching. One key idea is that a variety of learning opportunities need to be used to provide for individual differences among children in the classroom.

1. interlocking cubes (manipulative materials) stress a hands on approach in pupil learning. interlocking cubes such as unifix cubes may be used to teach basic operations such as addition, subtraction, multiplication, and division. A pupil may then learn, in a meaningful manner, to add five plus three by joining together five cubes and three cubes. The order of cubes may be reversed to show that 3+ 5 and 5+3 also egual eight.

2. Cuisenaire rods might well be manipulated to show , for example, the associative property of addition by taking two yellow rods, three black rods, and one white rod (2+3+1). These may then be considered in any order to again show that the sum will be 6.

3. attribute blocks may be sawed, using a jig saw, from plywood resulting in neat circles, squares, rectangles, and triangles. Pupils may then sort all the cut outs by geometric shape such as being circles only, or squares only, or rectangles

only, or triangles only. These geometrical shapes may be painted differently so that a pupil may select only those of blue color, for example, regardless of shape.

4. measuring instruments to be used by the teacher and pupils include a measuring tape indicating inches, feet, yards, and rods. A tape should also show the metric system of centimeters and meters. A pint, a quart, a gallon, and a bushel container, should also be available as should a liter in the metric system. A scale and a balance beam must be available for weighing.

5. a compass and a protractor should be readily available to develop and measure/make geometrical figures and angles.

6. base ten materials such as a place value chart with pockets for ones, tens, hundreds, and thousands. Congruent slops of paper may be place in a pocket to represent a value, e.g. three slips in the hundred's place to indicate three hundred.

7. toy money to be used in a play store to buy goods. Empty fruit and vegetable cans need to be brought to school. They should have necessary prices listed thereon. Pupils may then "buy" needed food items. Empty cereal boxes, candy wrappers, flour sacks, among other food items, may be added to the grocery shelves for "shopping" by pupils.

8. fraction kits with circles or bars divided into halves, thirds, fourths, and fifths, among others as needed. Thus, a third of a circle, for example, may be joined to a different third of a circle and pupils may see that two thirds is the end result. Addition, subtraction, multiplication, and division may be shown with the fraction kit. Equivalent fractions may be taught meaningfully using circles or bars from the fraction kit. Thus three fourths of a circle may be placed over six eighths of a circle to show equivalent fractions.

9. geoboards may be made and used to have pupils develop models of geometric figures. Short nails may be then be driven into the plywood. A rubber band can then be stretched around selected nails to make a square or triangle, for example, as these are being studied in ongoing units of study.

10. transparencies, made or purchased commercially, with the overhead projector can be wisely used in teaching mathematics (See Reys, et. al., 1995).

The author has noticed many teaching aides which have been made by teachers for use in teaching. These have included game boards, charts, graphs, tables of information in mathematics, hundreds board, cassettes for pupils to listen to while following along with the same words in the basal text, and

number lines, among others.

Teachers at mathematics workshop, too, have made excellent teaching aides. One aide consisted of a large beautiful elephant who was fed "peanuts." But, the "peanuts" made of construction paper, listing basic number pairs, could only be fed if the pupil gave the correct answer, such as 5+2= , contained on the peanut.

Assessment

Pupil progress may be noticed through the use of a variety of procedures. These procedures include the following:

1. teacher observation which may be used continuously to diagnose and remediate pupil difficulties in mathematics.
2. results from teacher written tests involving every day mathematics lessons.
3. state mandated test results with feedback to notice the kinds of errors made by pupils. These may be criterion referenced (CRT) or norm referenced tests.
4. pupil self evaluation in terms of quality criteria.
5. journal entries written by pupils as well as portfolio development.

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